(Translation)

APPLICATION FOR PATENT

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TITLE OF INVENTION: Method Building Capcitor Layer in MIM Structure

Submitted herewith is/are an application identified above pursuant to Article 42 of the Patent Act.

This 24th day of December, 2002

Patent Attorney: YOU ME Patent & Law Firm

To the Commissioner of
the Korean Industrial Property Office

Attachment: 1. Abstract, specification (and drawing)-one copy each

KOREAN INDUSTRIAL PROPERTY OFFICE

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Applicant(s): DONGBU ELECTRONICS CO., LTD.

COMMISSIONER

I, the undersigned, who have prepared English translation which is attached herewith, hereby declare that the aforementioned translation is true and correct translation of officially certified copy of the Korean Patent Application No. 10-2002-0083531 filed on December 24, 2002.

This 14th day of September, 2005

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[ABSTRACT OF THE DISCLOSURE]

[ABSTRACT]

The present invention is directed to a method for fabricating a capacitor in a MIM structure where a nitride film and a Ti/TiN film are stacked. The method comprises the steps of etching a Ti/TiN metal layer using a mixture gas consisting of Cl_2, CHF_3 and Ar, and etching the nitride film using a mixture gas consisting of Cl_2 and Ar.

[SPECIFICATION]

[TITLE OF THE INVENTION]

METHOD FOR FABRICATING CAPACITOR LAYER IN MIM STRUCTURE

[BRIEF DESCRIPTION OF THE DRAWINGS]

Fig. 1 is a view showing a MIM capacitor structure formed by a general etching process;

Fig. 2 is a view showing a MIM capacitor structure when a nitride film is etched by an etching process according to the present invention; and

Fig. 3 is a flow chart illustrating a metal RIE process for forming a residual even nitride film according the present invention.

[DETAILED DESCRIPTION OF THE INVENTION]

[OBJECT OF THE INVENTION]

[FIELD OF THE INVENTION AND CONVENTIONAL ART IN THE FIELD]

The present invention relates to a fabrication method of a semiconductor device, and more particularly to a method for fabricating an improved MIM capacitor, which is capable of effectively removing residues of nitride in the fabrication of the MIM capacitor.

Capacitors used in a semiconductor device are generally classified into a PIP (poly insulator Poly) structure and a MIM (metal insulator metal) structure. Each structure is adequately selected according to its use. The MIM structure is mainly used for a semiconductor device using a high frequency. This is because a high frequency device undergoing a variation of characteristic of device due to a RC delay is preferable to employ the MIM structure using metals having electrical property, which is as good as possible.

Fig. 1 shows a general MIM structure. As shown in Fig. 1, the MIM structure comprises a first metal layer 11, an insulation line 12 and a second metal layer 13, which are stacked in order.

The first metal layer 11 includes two Ti/TiN films and an AlCu film sandwiched between them, for example. The second metal layer 13 includes one Ti/TiN film, for example. The insulation film 12 is located between the first and second metal layers and is formed of a nitride film, for example.

A metal reactive ion etching process is commonly used to fabricate the capacitor in the above-described MIM structure. However, in this process, nitride

residues 14 are roughly formed on a surface of the nitride film.

The formation of the rough nitride residues 14 is due to the use of a thin nitride film and the inadequacy of process conditions, which result in small etching margin and application disability of process conditions prominent in removal capacity of nitride.

In addition, the rough nitride residues are not removed in subsequent processes as the property of the nitride film is changed in a metal cleaning process. If etching time is increased in order to remove the nitride residues, a lower layer is revealed here and there. This causes pattern badness, which is a factor of a pattern short, in a subsequent patterning process. Therefore, there is a limit to the increase of the etching time.

[TECHNICAL TASK OF THE INVENTION]

In considerations of the above problem, it is an object of the present invention to improve a MIM characteristic, raise stability of processes in a metal etching, and increase a process margin of subsequent processes by providing a process by which a nitride film can be evenly etched.

[CONFIGURATION AND OPERATION OF THE INVENTION]

The present invention provides an etching process by which a surface of nitride residue can be evenened by changing etching conditions of a Ti/TiN film as an upper metal layer in an reactive ion etching process and etching conditions of a nitride film as a dielectric line such that only the nitride film is effectively removed after the Ti/TiN film is completely removed.

A preferred embodiment of the present invention will now be described in detail with reference to the accompanying drawings.

Fig. 2 is a view showing a MIM capacitor structure when a nitride film is etched by an etching process according to the present invention. As shown in Fig. 2, a first metal layer 21, a dielectric layer 22 and a second metal layer 23 are sequentially stacked to form a capacitor in a MIM structure.

The first metal layer 21 includes two Ti/TiN films and an AlCu film sandwiched between them, for example. The second metal layer 23 includes one Ti/TiN film, for example.

The dielectric layer 22 functioning as a capacitor is made of nitride and is located between the first and second metal layers 21 and 23.

As shown in Fig. 2, a residual film 24 of the dielectric layer 22 formed by an etching process according to the present invention has a even surface.

Now, an etching process for forming the residual nitride film shown in Fig. 2 will be described.

Fig. 3 is a flow chart illustrating a metal RIE process for forming a residual even nitride film according the present invention. As shown in Fig. 3, a process for etching the dielectric layer in the MIM structure is performed in order of first metal layer deposition (S31), dielectric layer deposition (S32), second metal layer deposition (S33), photoresist film patterning (S34), second metal layer etching (S35) and dielectric layer etching (S36).

First, Ti/TiN, AlCu and Ti/TiN stacking metal layers corresponding to the first metal layer are deposited at a thickness of about 5,000Å, using a sputtering process or the like.

Next, the nitride film (PE-SiN), which is the dielectric layer functioning as the capacitor, is deposited at a thickness of about 600Å. Here, the thickness of the dielectric layer need not be limited as 600Å, but suitably 400 to 800Å.

Next, Ti/TiN film as the second metal layer is formed on the top of the nitride film, with Ti and TiN deposited at thicknesses of 500Åand 1500Å, respectively. At this time, the thicknesses of Ti and TiN need not be limited as the above-mentioned values, but the thickness of Ti can be 300 to 700Å, the thickness of TiN can be 1300 to 1700Å, and, consequently, a total thickness of the second metal layer can be 1600 to 2400Å.

Next, after a photoresist film is applied at a thickness of 11,000 to 15,000Åon the top of the second metal layer, a photoresist pattern is formed by selectively etching the photoresist film.

Next, using the photoresist pattern as a mask, a metal RIE is performed under the following conditions. First, as etching conditions of Ti/TiN as the second metal layer, a source of 8mT/900W and a bias power of 150w are used and a plasma of a mixture of $50Cl_2$/ $10CHF_3$ /50Ar is applied as a reactive gas. The second metal layer is etched for about 45 to 55 seconds, preferably, about 50 seconds.

In this step, it is important to remove nitride residues using CHF_3. Although the etching process for the second metal layer is performed by Cl_2, CHF_3 is additionally used to protect a side wall of Ti/TiN film and remove nitride interfacing with Ti to some

degree, and Ar is used to improve uniformity.

When the etching for Ti/TiN as the second metal layer is completed, the etching conditions for the nitride film is changed to a source of 8mT/900W, a bias power of 150W and a reactive gas of $50Cl_2/100Ar$. The nitride film is etched for about 4.5 to 8 seconds, preferably, about 6 seconds

In this step, residual metal is removed using Cl_2 without using CHF_3. This is because the MIM characteristic is deteriorated due to an over-etching of the nitride film if the CHF3 is used in this step. In addition, in this step, a ratio of Cl_2 to Ar is 1 : 2.

This allows effective removal of metal residues and improvement of uniformity. On the other hand, time required for this step is set as 10 to 15% of the etching time of the upper metal layer. This is the most pertinent time in considerations of a pertinent thickness of residual nitride and the removal of the metal residues.

On the other hand, a bias power used for the etching is set as more than 150W.

[ADVANTAGE OF THE INVENTION]

According to the above-described etching process, the nitride film can be evenly etched, which results in improvement of the MIM characteristic, stability raise of processes in a metal etching, and increase of a process margin of subsequent processes.

[CLAIMS]

1. A method for fabricating a capacitor in a MIM structure where a nitride film and a Ti/TiN film are stacked comprising:

a step of etching a Ti/TiN metal layer using a mixture gas consisting of Cl_2, CHF_3 and Ar; and

a step of etching the nitride film using a mixture gas consisting of Cl_2 and Ar.

2. The method of claim 1, wherein, in the step of etching a Ti/TiN metal layer, the Ti/TiN metal layer is etched for 45 to 55 seconds using a mixture gas consisting of Cl_2, CHF_3 and Ar in the ratio of 5:1:5.

3. The method of claim 1 or 2, wherein, in the step of etching the nitride film, the nitride film is etched for 5 to 7.5 seconds using a mixture gas consisting of Cl_2 and Ar in the ratio of 1 to 2.

4. The method of claim 3, wherein, in the step of etching a Ti/TiN metal layer and the step of etching the nitride film layer, a bias power of 150W – 250W is applied.

5. The method of claim 3, wherein, in the step of etching a Ti/TiN metal layer and the nitride film layer, the bias power of the step of etching a Ti/TiN metal layer and the step of etching the nitride film layer is the same.